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DOES EXCHANGE RATE HAVE ASYMMETRIC IMPACT ON TRADE BALANCE? FRESH INSIGHTS FROM COMBINED COINTEGRATION

SOLOMON PRINCE NATHANIEL
University of Lagos, Akoka, Nigeria

Abstract:

The study examines the asymmetric impact of exchange rate on the trade balance in Nigeria relying of time series data that spans 1960-2016. The Non-linear ARDL bounds test and the Bayer and Hanck (2013) test established a cointegrating relationship among the variables after accounting for structural break in the series. The Block Exogeneity Wald Tests affirmed the bidirectional causality between the variables. Findings establish the asymmetric impact of exchange rate on the trade balance in Nigeria, but unable to confirm the existence of the J-curve Phenomenon. This reveals that the devaluation of the Naira may not be a viable decision if the intention is to curb the persistent deficit in the country's trade balance. Policies that could help curtail these deficits and enhance sustainable growth were suggested.

Key words: *Trade balance, Nonlinear ARDL, Exchange rate, Nigeria*

1. Introduction

The rhetoric and empirics that surround the perceived relationship between trade balance and exchange rate have been well established in the literature. The literature is awash with studies that tried to explore the role played by exchange rate, in terms of its impact on the trade balance. Will exchange rate depreciation or appreciation improve or worsen a country's trade balances? Is an important question greeted with mixed results (Kyophilavong *et al.,* 2018). A good understanding of the link between these variables can help policymakers initiate a viable monetary policy (Rehman & Aftab, 2015). The stability of the exchange rate is sacrosanct. The advantages associated with this is hydra-headed, as it can help promote growth (Mrabet & Alsamara 2018; Akinbobola & Oyetayo 2010; Apollos 2015; Vieira & MacDonald 2012), determine export (Adaramola 2016; Oyovwi 2012) and ensures a countries competitiveness. In spite of these advantages, the exchange rate in Nigeria has remained grossly unstable over the years. In 1981, for instance, it was ₦0.61 to one US dollar. It slipped to ₦2.0206 in 1986, ₦9.9095 in 1991, ₦21.886 in 1996, ₦111.9433 in 2001, and it was ₦153.8616 and ₦199.268 in 2011 and 2015 respectively. The trade balance has not fared well as it keeps oscillating between positive and negative

values. In 1981, the country witnessed a deficit of -₦1.8 billion. In 1986, it assumed a positive value of ₦2.9 billion. From 1991 to 1997, the country enjoyed a trade surplus, and this continued till 2014 with 1998 being the only exception. In 2015, however, the trade balance was in a deficit (₦2,230.9) corresponding to ₦199.268 exchange rate to a dollar. Findings have shown that a greater part of the surpluses the country witnessed was mainly driven by oil-export, not non-oil export. See Table1 below.

Table 1: Trend of trade balance, exchange rate, trade balance (with oil) and trade balance (without oil) in Nigeria

Year	Exchange rate	TB (with oil)	TB (without oil)	Total TB
2010/11	152.3297	11,279.6	- 7,038.8	4,240.8
2011/12	155.9402	11,195.7	- 5,823.0	5,372.8
2012/13	155.7537	11,702.5	- 5,879.9	5,822.6
2013/14	156.9828	9,791.9	-7,370.2	2,421.7
2014/15	199.268	6,459.3	-8,690.2	-2,230.9
2015/16	305.3421	5,436.2	-5726.3	-290.1

Note: TB represents trade balance. All figures are in billions of Naira.
Source: CBN Statistical Bulletin, 2016.

The negative values in the trade balance in 2015 and 2016 could be attributed to the recession the country witnessed during these periods. The country bounced back in 2017 to maintain a positive trade balance of 4,035.5billion.

The principal reason behind exchange rate policy is to enhance its stability (Kyophilavong *et al.,* 2018). As a result, in order to curtail the upward and downward swings in both variables, Nigeria has moved from one exchange rate policy/regime to the other. The fixed exchange rate regime was practised between 1960 and 1972. There was a paradigm shift to the managed float system from 1973 to 1978. The Dutch Auction System existed in 1987. This system did not yield the desired result giving room for the re-introduction of the pegged exchange rate system in 1994. Between 2006 and 2013 the country settled for the wholesale Dutch auction system having previously adopted the retail Dutch auction system. At present, the managed float system is being favoured against other alternatives. Previous studies in Nigeria arrived at a conflicting result. Some are in support of a positive impact (Ogbonna 2009, 2011; Igue & Ogunleye 2014; Oladipupo 2011) while others discovered the opposite (Loto 2011; Omojimite & Akpokodje 2010). Poor methodology could have contributed to the discrepancies in the results. To make up for this inadequacy, the present study employs the asymmetric ARDL approach (with the longest annual time series data in the literature) since most time series data are known to exhibit a non-linear trend. With this, the current study adds to the existing literature as the researcher is not aware of any study in Nigeria that has estimated the relationship between both variables (bivariate model) in a non-linear framework. Moreover, non-linear models are known to have greater explanatory power than linear models (Altintas & Yacouba 2018; Meo *et al.* 2018).

This study is organised as follows: Sec. 2. presents a brief literature review. Sec. 3. contains the data source and methodology. In Sec. 4. results are presented and discussed. Sec. 5. gives conclude and policy direction.

2. Literature Review

The three major theories that link both variables in literature are: Elasticity Approach also referred to as the Bickerdike-Robinson-Metzler Condition, postulates that the adjustment of trade balance is closely knitted with the elasticity of demand. Demand elasticities, export and import supply, and the initial trade volume are the core determinants of changes in the foreign currency value (Bickerdike, 1920). However, this approach had been further modified by Metzler (1945) and Robinson (1947). The Monetarist Approach assigned deficit in trade balance to an increase in money supply. This makes it a monetary phenomenon (Dunn & Mutti, 2000). The Keynesian Absorption Approach was first modelled by Meade (1951) and Alexander (1952). This approach is the combination of Keynesian macroeconomics and the elasticities approach. There will be an improvement in trade account if domestic absorption is less than domestic output growth (Dunn & Mutti, 2000). The phenomenon of the J-curve has gained more attention in the literature. Studies that have failed to establish its existence include (Wijeweera & Dollery 2013; Kyophilavong *et al.* 2016; Shahbaz *et al.* 2012; Musawa 2014; Awan *et al.* 2012; Schaling & Kabundi 2014; Oskooee & Cheema 2009; Rahman *et al.* 2012; Shahbaz *et al.* 2010) while studies that confirm its existence include (Gupta-Kapoor & Ramakrishnan 1999; Bahnmani-Oskooee & Harvey 2010; Narayan 2004; Wijeweera & Dollery 2013; Bahmani-Oskooee & Kutan 2009; Bhmani-Oskooee & Wang 2006)

Kyophilavong *et al.,* (2018) confirmed the existence of no J-curve between Lao and Thailand. Economic growth in Lao deters its trade balance. On the flip side, a rise in Thailand's income is accompanied by trade balance improvement in Lao. Musawa (2014) examined a similar relationship for Zambia relying solely on the VECM approach. The impact of the exchange rate on the country's trade balance was only felt in the long run thereby failing to confirm the J-curve hypothesis for Zambia. With the same methodology, but with a different data span with that of Musawa (2014), Lucy *et al.* (2015) estimate a similar relationship for Ghana. Findings suggest that once the Ghana Cedes is depreciated, the trade balance of the country improves. The authors, however, call for the continuous depreciation of the Cedes in order to expunge deficit in the trade balance.

Šimáková (2014) used the VECM with data spanning 1997-2013 to investigate the J-curve hypothesis in aggregate and disaggregate framework. Instead, the study discovered an inverse J-curve relationship. This suggests that depreciation improves the trade balance up to a certain threshold, after which it dwindles. Prakash & Maiti (2016) incorporated political stability into the model in Fiji. The impact of exchange rate on trade balance was strong while that of political instability was not significant. Similar to the finding of Prakash & Maiti (2016) with a similar methodology Buba *et al.* (2018) did not discover any significant effect of political instability on the trade balance in Thailand. For them, exchange impacts on trade balance because of the country's massive importation.

Chiu & Sun (2016) examined a similar relationship for seventy-six countries. They alluded importance to the savings rate. They discovered that a savings rate in excess of 14.8% can significantly induce the trade balance. Bahmani-Oskooee & Fariditavana (2016) ascertained the J-curve existence for the US relying on asymmetric (NARDL) and non-asymmetric ARDL approach for six of its trading partners. The NARDL approach performed better than the former as findings support the phenomenon in five out of the six countries, as opposed to just two for linear ARDL.

Khan *et al*. (2016) relying on the ARDL approach, could not establish the existence of the J-curve relationship for Pakistan. They concluded that the devaluation of Pakistan currency will not be in favour of the country's trade balance. Hassan *et al.* (2017) used the ARDL approach with time series data spanning 1989Q1-2015Q4 to explore the same relationship in Nigeria. Findings support the significant impact of fiscal balance on the exchange rate. Jibrilla & Mohammed (2015) provided evidence of the slow impact of exchange rate devaluation on trade balance from an asymmetric ECM modelling with monthly data for Nigeria. Their findings laid partially credence to the Dutch Disease phenomenon. They concluded that resulting in Naira devaluation as a tool for improving the trade balance will be a *'wild goose'* chase. Rather, diversifying the economy is key.

3. Data Source and Methodology

The study used annual data spanning 1960-2016 from the Central Bank of Nigeria Statistical Bulletin (2017). The Non-linear ARDL model advanced by Shin *et al.* (2014) was used for analysis. The linear form of the model is given as:

$$TB_t = \psi_0 + \psi_1 EXR_t + \varepsilon_t \quad (1)$$

Where TB_t, EXR_t and ε_t are the trade balance, exchange rate and the error term respectively. All variables are in their log-linear form. Given the above specification, it would be difficult to capture the asymmetric impact of exchange rate on the trade balance. We can account for asymmetries by re-specifying Eq.1 as:

$$TB_t = \xi_0 + \xi_1 EXR_t^+ + \xi_2 EXR_t^- + \varepsilon_t \quad (2)$$

The asymmetries in the variable are accounted for by introducing both the positive and negative values of the exchange rate in the equation. $EXR_t^+ \; and \; EXR_t^-$.

$$EXR_t^+ = \sum_{i=1}^{t} \Delta EXR_i^+ = \sum_{i=1}^{t} \max(\Delta EXR_i, 0) \quad (3)$$

$$EXR_t^- = \sum_{i=1}^{t} \Delta EXR_i^- = \sum_{i=1}^{t} \min(\Delta EXR_i, 0) \quad (4)$$

From Eq.2., ξ_1 and ξ_2 capture the magnitude of both the positive and negative shocks of the exchange rate (in the long-run) on trade balance respectively. +To capture the short run effect, we can re-specify Eq.2 as:

$$\Delta TB_t = \gamma_0 + \gamma_1 TB_{t-1} + \gamma_2 EXR_{t-1}^+ + \gamma_3 EXR_{t-1}^- + \sum_{k=1}^{m} \omega_k \Delta TB_{t-k} + \sum_{k=1}^{m} \omega_k \Delta EXR_{t-k}^+ + \sum_{k=1}^{m} \omega_k \Delta EXR_{t-k}^- + \mu_t \quad (5)$$

From Eq.5, the long run impact of both positive and negative changes in the exchange rate are

$\xi_1 = -\gamma_2/\gamma_1$ and $\xi_2 = -\gamma_3/\gamma_1$. $\sum_{k=1}^{m} \omega_k \Delta EXR_{t-k}^+$ and $\sum_{k=1}^{m} \omega_k \Delta EXR_{t-k}^-$ are both the short run impact of positive and negative changes respectively.

4. Presentation and Discussion of Results

The study proceeds to examine the characteristic of each of the variables used in the study. The descriptive statistic of the variables along with the correlation matrices is shown in Table 4.1 below.

Table 4.1: Descriptive Statistic of Variables

Variables	TB	EXR
Mean	5.8303	1.9364
Median	6.1650	1.5122
Minimum	0.6469	-0.6044
Maximum	8.6695	5.7214
Skewness	-0.5100	0.2459
Kurtosis	2.2219	2.3719
Jarque-Bera	3.0178	7.2012
Probability	0.2211	0.0273
TBL	1.0000	
EXR	(0.430)***	1.0000

*** shows significance at 1%.

Results show that the mean of each of the variables almost equals their median values. The trade balance is positively skewed while the exchange rate is negatively skewed. Both variables are platykurtic and positively correlated. Their probability values confirm the normality of trade balance, not the exchange rate.

As a precautionary motive to avoid spurious regression, the study proceeds with the Augmented Dickey Fuller (ADF), Philips and Perron (PP), Kwiatkowski-Phillips-Schmidt-Shin KPSS (1992) stationarity tests and the Zivot and Andrew (ZA) (1992) unit root to account for a structural break in the series.

Table 4.2a: ADF and PP unit root tests (without break)

Variables	ADF	PP	KPSS
TBL	-3.264039(1)**	-3.264039(1)**	0.393567
EXR	0.633842(1)	0.367652(1)	0.844688
∆TBL	-7.840120(1)*	-8.411754(1)*	0.108854
∆EXR	-5.714509(1)*	-5.765492(1)*	0.266622

** and * indicate significance at 5% and 1% respectively.

Table 4.2b: Zivot-Andrews Unit root test

Variables	At levels		At First Difference	
	T-Stat.	Time Break	T-Stat.	Time Break
TBL	-3.369916(2)**	[2004]	-5.541456(2)**	[2002]
EXR	-0.515989(1)	[1999]	-3.833020(1)**	[1997]

Note: ( ) shows lag length of the variables. ** show significance at 5%.

The four tests are in harmony. While trade balance is significant at levels, exchange rate became significant only after first difference. It should be noted that the ADF and PP tests have a null hypothesis of unit root, while the KPSS test has a reverse null hypothesis of no unit root. Since the ARDL approach perform better in the presence of mixed level of stationarity we can therefore proceed with the ARDL bounds test. See Table 4.3.

Table 4.3: NARDL Bounds Test Results

Estimated models Cointegration	Optimal lag	Break year	F-stat.	Diagnostic tests Normality	ARCH	
TBL = *f* (EXR)	1, 1, 1	2004	5.696579*	0.228	0.264	✓
EXR =*f* (TBL)	1, 1, 0	1999	10.83258*	0.056	0.483	✓
	For: **TBL = *f* (EXR)**					
	Critical values bounds					
	Lower Bound	Upper Bound				
5% critical value	3.10	3.87				
10% critical value	2.63	3.35				
1% critical value	4.13	5.00				
	For: **EXR = *f* (TBL)**					
	Critical values bounds					
	Lower Bound	Upper Bound				
5% critical value	3.62	4.16				
10% critical value	3.02	3.51				
1% critical value	4.94	5.58				

Note: * indicate significance at 1% level.

The results from the bounds tests above affirm the presence of cointegrating relationship between the variables as the F-statistic of the variables is greater than the 5% significance level of the upper bound. To complement the NARDL bounds test, the study also relied on the Bayer and Hanck (2013) combined cointegration test. The test is a combination of other individual tests like (Johansen 1991; Boswijk 1995; Engle & Granger 1987; Banerjee *et al.,*1998). The Fisher equation for the test are shown in Eq. (6) and (7) below;

$$EG-JOH = -2[\ln(\rho_{EG}) + (\rho_{JOH})] \quad (6)$$

$$EG-JOH-BO-BDM = -2[\ln((\rho_{EG}) + (\rho_{JOH}) + (\rho_{BO}) + (\rho_{BDM})] \quad (7)$$

ρ_{BDM}, ρ_{BO}, ρ_{JOH} *and* ρ_{EG} are the test probability of individual cointegration tests.

Table 4.4: Bayer-Hanck test for Cointegration

Estimated models	EG-JOH	EG-JOH-BO-BDM	Cointegration
TBL =f(EXR)	11.524**	22.278**	Yes
EXR =f(TBL)	13.431**	23.267**	Yes
5% critical value	11.229	21.931	

Note: ** indicate significance at 5% levels.

The Fisher statistic are greater than the 5% critical values of 11.229 and 21.931 respectively, we can safely conclude that the variables (TBL and EXR) are cointegrated.

Table 4.5: ARDL Short-run and Long-run Analysis

Dependent Variable: TBL

Variables	**Coefficients**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.090500	0.044413	2.037685	0.0465
D(EXR_POS)	-0.655371	0.151043	-4.338959	0.0001
D(EXR_NEG)	-9.202277	5.508661	-1.670511	0.1012
TBL(-1)	-0.776268	0.135842	-5.714509	0.0000
EXR_POS	-0.603417	0.129678	-4.653184	0.0000
EXR_NEG	-0.00400	0.28000	-0.014285	0.0002
Eq(-1)	-0.655371	0.133274	-4.917458	0.0000
R^2	0.52453			
D-W Stat	1.83793			
Diagnostic Checks Test	F-statistic			
X^2 ARCH	0.5678			
X^2 Serial correlation	0.2343			
X^2 Normality	0.1432			

From Table 4.5 above, the lag value (first lag) of trade balance exacts a significant impact on its current value. A 1% increase corresponds to about 77% decrease in the trade balance. In the short run, a positive shock in the exchange rate will lead to about 65% decrease in the country's trade balance holding the effects of other variables constant. The same impact, but of different magnitude is associated with a negative shock. However, the impact of a negative shock is not significant. As a negative shock is accompanied with about 9.2% decrease in the trade balance. The magnitude of the impact between positive shocks in the short run differs from that of the long run. In the long run, a positive shock in the exchange rate will lead to 60% decrease in trade balance. The impact of a negative shock, in the long run, is consistent with that of the long run. Both are insignificant and their impacts are negative. An interesting discovery from the finding is that the exchange rate has an asymmetric impact on the country's trade balance. This is intuitive. More so, the negative impact of a positive shock of the exchange rate in both time periods negates the existence of the *J-curve* phenomenon for Nigeria. This is in line with the findings of Wijeweera & Dollery (2013), Kyophilavong *et al.* (2016), Shahbaz *et al.* (2012), Musawa (2014), Kyophilavong *et al.,* (2018) and Jibrilla & Mohammed (2015) for Nigeria. Suffice to say that, devaluation of the Naira may not be the solution to the persistent deficit in the country's trade balance. It is a tip-off to the relevant authority to incorporate viable policies that will enhance efficient proper exchange rate management which will in turn impact positively on its trade balance. The inability of the country to record a surplus in its trade balance has made it difficult for the proposed West Africa Monetary Zone (WAMZ) to properly take off, as this happens to be one of the criteria for its formation. The error correction term conforms to economic theory with a significant t-

statistic and a negative coefficient. The study is also in line with the various OLS assumptions.

Table 4.6: Block Exogeneity Wald Tests

Dependent Variable: TBL	Chi-sq	df	Prob.
EXR	7.311138	2	0.0258
All	7.311138	2	0.0258
TBL	13.53815	2	0.0258
All	13.53815	2	0.0258

This test was used to confirm the direction of causality between the variables since impact does not necessarily mean causation. The test suggests the existence of a bidirectional causality between the variables.

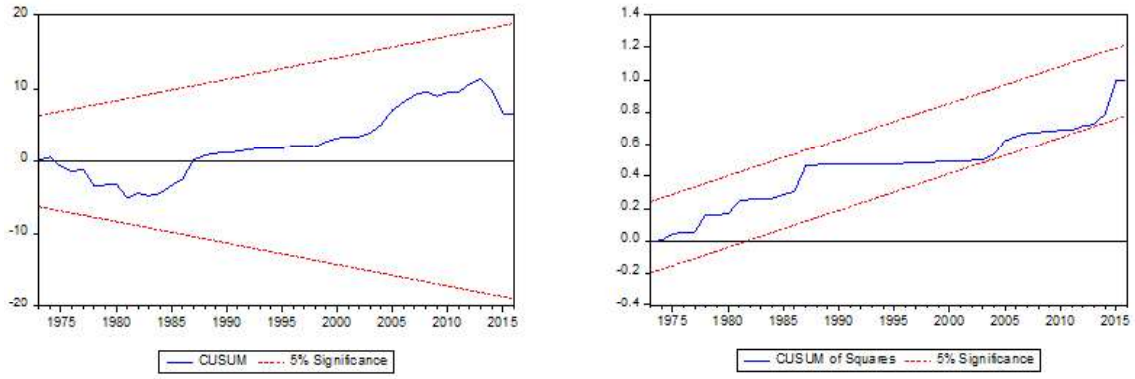

Figure 1: CUSUM and CUSUM (sq) Graph

The CUSUM and CUSUM (sq) Graph of Brown *et al.* (1975) confirm the stability of the model with the residuals within 5% critical bond. Therefore, the study can be a useful tool for forecasting and policy implementation.

5. Conclusion and Policy Direction

The study examines the asymmetric impact of exchange rate on the trade balance in Nigeria with time series data for the period 1960-2016. The Non-linear ARDL bounds test of Shin *et al.,* (2014) the Bayer and Hanck (2013) test established a cointegrating relationship among the variables after accounting for a structural break in the series. The Block Exogeneity Wald Tests confirmed the bidirectional causality between both variables. Positive and negative shocks in exchange rate were associated with a negative impact on the country's trade balance, but only the positive shocks were significant. This confirmed the asymmetric impact of exchange rate on trade balance. To improve the country's trade balance, attention should be shifted to exportation, but not totally on primary products. There is also a dire need to minimize importation, especially on commodities that can be

produced locally. Since the country currently has the largest population in Africa, meeting domestic need may prove difficult. However, providing adequate infrastructure and creating an enabling economic and political environment to help business thrive could be the game changer.

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